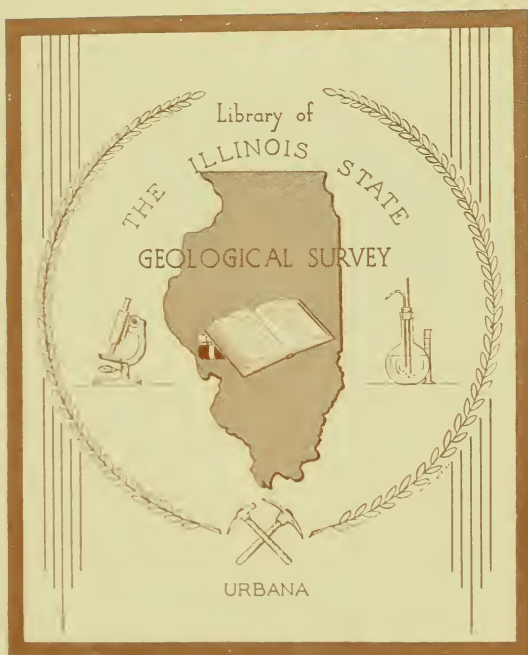








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# GEOLOGIC STRUCTURE MAP OF THE NORTHWESTERN ILLINOIS ZINC-LEAD DISTRICT

by

J. C. Bradbury  
R. M. Grogan  
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DIVISION OF THE  
ILLINOIS STATE GEOLOGICAL SURVEY  
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## ABSTRACT

Knowledge of geologic structure is important in prospecting for zinc-lead ores in northwestern Illinois. A new structure contour map on the scale of 2 inches to the mile, revised and enlarged from the original 1947 edition, has been prepared, based on drill records and key beds in outcrop. The structure mapping delineates three main synclinal directions - northeast (major), and east and northwest (subsidiary). All three are potentially ore-bearing.

## INTRODUCTION

Information on geologic structure is important in prospecting for zinc-lead ore in northwestern Illinois. Structure contour maps published by the Illinois State Geological Survey in 1947 (Willman and Reynolds, 1947) have aided in the development of the district. Further studies by Survey personnel have provided information for mapping new areas and for revising the 1947 maps.

Finding structures of the type known to be commonly associated with the ore deposits offers the best possibilities for localizing drilling in large parts of the mineralized region of northwestern Illinois. Where outcrops or drill data are relatively abundant, structure mapping may be an important help in selecting fairly large areas as being more favorable than others. In outlying areas the control points are widely scattered and the structures rather ill-defined, so that drilling is needed to supplement the outcrop datum points.

The area covered by structure mapping includes the principal mineralized area and the once-important Elizabeth lead-producing area (fig. 1). A geologic map of the East Dubuque quadrangle (fig. 2) is included to complete areal geologic coverage of the mineralized region of northwestern Illinois. The areal geology of the Galena and Elizabeth quadrangles was mapped by Trowbridge and Shaw (1916).

The structure contour map (pl. 1) was made by plotting the elevation of the top of the Guttenberg ("Oilrock") member of the Decorah formation at all points where it is known or where its elevation can be calculated from other stratigraphic horizons. These datum points are: 1) drill holes in which the depth to the Oilrock is known, 2) outcrops of the Oilrock, and 3) outcrops that contain distinctive beds whose stratigraphic position and distance above or below the Oilrock is known. The accuracy of this method depends on correct identification of the outcropping beds and a uniform thickness of the strata throughout the area mapped. Drawing of the contours is largely interpretive on much of the map, and the possibility of other interpretations must be recognized.

The identifying characteristics of the structural horizons have been described by Willman and Reynolds (1947).

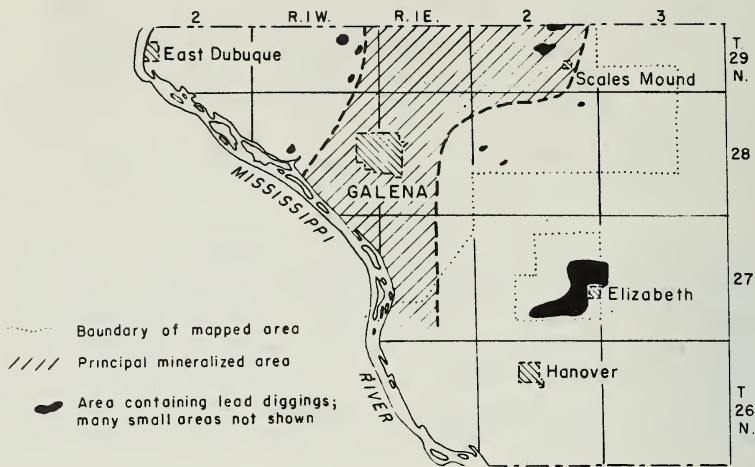


Fig. 1.- Index map of the western two-thirds of Jo Daviess County, showing the area mapped. (Modified from Willman et al., 1946.)

The structure contour maps are available on two scales. A single map on a scale of 2 inches to the mile accompanies this report as plate 1. It includes structure contours and locations of known zinc mines and deposits. A set of map sheets (see fig. 3), on a scale of 500 feet to the inch, showing all datum points used in drawing contours, is available for inspection at the Survey's offices in Urbana. Black-line ozalid prints of single sheets or of the complete set of these maps are available at nominal cost. The datum points include most of the prospect holes drilled since the early 1900's and help to indicate the heavily drilled areas where further prospecting would not be practical.

Willman and Reynolds mapped the areas for sheets 7, 8, 14, 15, 20, and 22 (fig. 3) in 1947. Grogan and Bradbury subsequently made further studies on outcrops in parts of these areas and also mapped the areas for sheets 9, 10, 11, 17, 18, 19, and 21. Bradbury and Cronk mapped the areas for sheets 1, 2, 3, 4, 5, 6, 12, and 13 at the western end of Jo Daviess County and sheets 23 and 24 in the Elizabeth area.

The Division of Stratigraphy and Areal Geology provided stratigraphic interpretation of drill hole data. Principal contributors were Paul Herbert, R. C. McDonald, and T. C. Buschbach. Herbert also helped to make stratigraphic correlations in the field.

All mining companies active or recently active in northwestern Illinois, many individual miners and prospectors, and many independent drillers have aided greatly the preparation of the structure map by furnishing maps, records and samples of drill cuttings.

## ORE DEPOSITS AND THEIR RELATION TO GEOLOGIC STRUCTURE

Most ore deposits in northwestern Illinois are associated with synclines, or structural depressions. Deposits are of two types - curved or arcuate ore bodies and long, straight ore bodies. The curved ore bodies appear to be irregularly distributed along broad synclines that trend northeast and east and

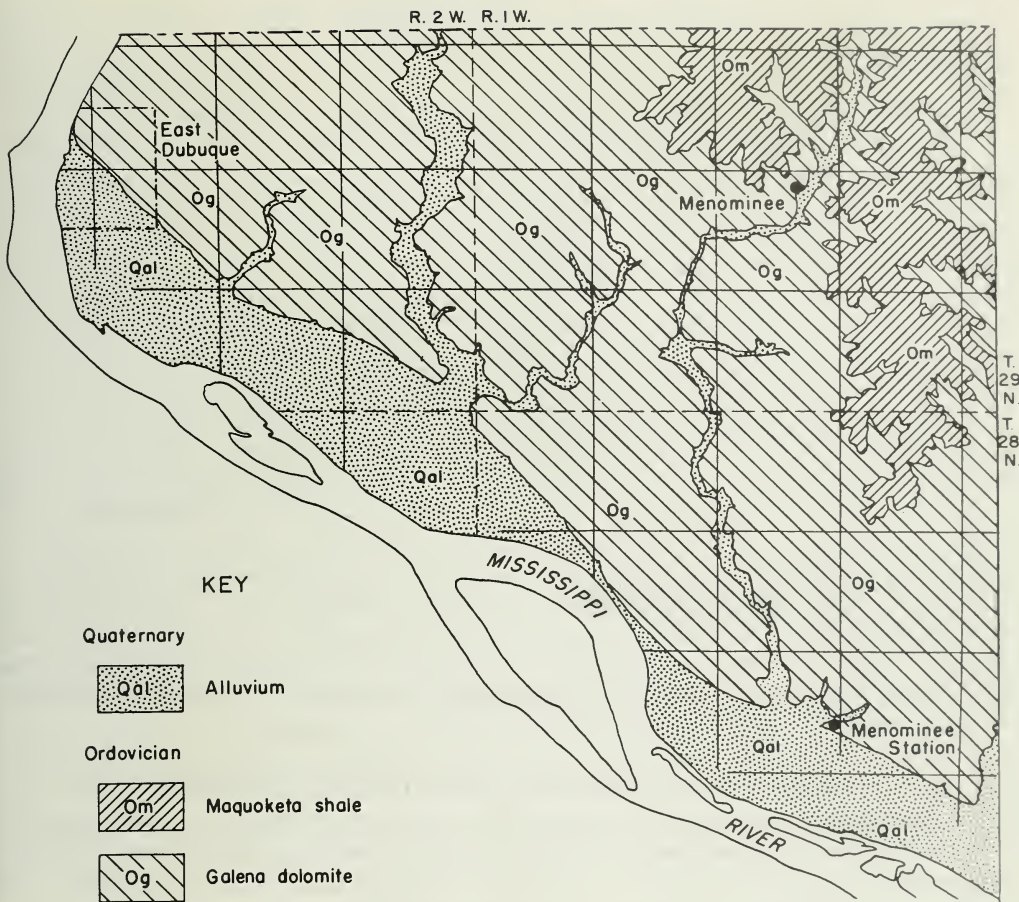


Fig. 2 - Areal geology of the East Dubuque quadrangle.

are located either on the lower slopes or along the bottoms of the synclines. These ore bodies normally have an east trend and, along the northeast-trending synclines, are arranged en echelon.

The long, straight ore bodies, however, appear to be related to narrow structural zones, probably shear zones, which in Illinois trend north to northwest and cut sharply across the broad regional eastward-trending anticlines and synclines. A narrow syncline, which is confined fairly closely to the area of the ore body, commonly is present with both types of deposits and is believed to be mainly the result of collapse following solution of some of the limestone beds. These solution-collapse structures probably were formed by the mineralizing solutions and therefore followed the regional deformation.

Within the ore deposits, the rocks have both vertical and inclined crevices and shear zones and generally are faulted on a small scale. In many places the strata are tilted and brecciated, and incompetent beds are contorted. In the barren ground next to the deposits the strata are little disturbed.

Because of these relationships, the object of structural studies as related to prospecting is to delimit synclinal areas and find surface evidence of dis-

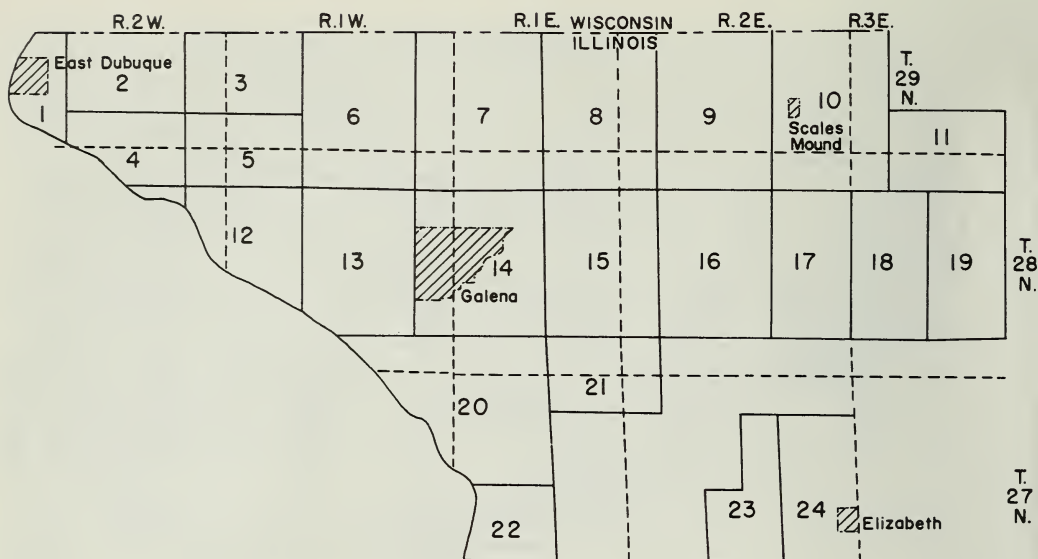


Fig. 3 - Index map for large-scale map sheets on open file. Area numbers correspond to those of maps available at the Survey in Urbana.

turbed rock. The point cannot be overemphasized, however, that the presence of favorable structural conditions does not necessarily indicate the presence of ore. Many structures are not ore-bearing.

### PRINCIPAL SYNCLINAL STRUCTURAL FEATURES

The principal synclinal trends of the northwestern Illinois district are northeast, east, and northwest (pl. 1). All three of these trends are ore-bearing in Wisconsin, but only the northeast- and northwest-trending synclines have been productive in Illinois to the present time.

The northeast-trending synclines - Vinegar Hill, Galena, and Smallpox Creek - are the major folds of the area. They are persistent features that apparently are continuous across the district.

The east- and northwest-trending synclines cross or branch from the major northeast-trending synclines. They generally are subsidiary structures and are not so persistent as the synclines that trend northeast. They can in general be traced for no more than a few miles. A possible exception is the northwest-trending syncline, which contains the Blackjack and Bautsch ore bodies south of Galena. This syncline appears to end against a strong structural high in secs. 32 and 33, T. 28 N., R. 1 E. However, a rather poorly defined syncline on the northwestern side of the structural high in secs. 32 and 29, T. 28 N., R. 1 E., and secs. 25 and 24, T. 28 N., R. 1 W., may be a continuation. There is also a possibility that the sharp northwest-trending syncline several miles to the northwest in sec. 4, T. 28 N., R. 1 W., and sec. 33, T. 29 N., R. 1 W., is on the same trend.

### NORTHWEST-TRENDING ORE BODIES

Linear northwest-trending ore bodies have furnished most of the zinc ore produced in northwestern Illinois. Two major groups of such ore bodies occur

in Illinois - one composed of the Blackjack, Bautsch, Pittsburg, and Gray ore bodies, and the other of the Graham-Snyder, Graham-Ginte, and Feehan-Spil-lane ore bodies (pl. 1).

These groups of ore bodies appear to follow narrow northwest-trending synclines, which may have resulted from collapse accompanying solution of limestone beds along shear zones. Together with the heavily mineralized northwest-trending Kennedy syncline in the western part of the Hazel Green-Shulls-burg subdistrict in Wisconsin (Heyl et al., 1955), which is adjacent to the north-western Illinois district on the north, synclines of the Graham-Snyder and Black-jack groups form a roughly north-trending belt of en echelon linear ore-bearing structures, each about two miles long. As no other northwest-trending groups of ore bodies comparable to the Kennedy have been found in the relatively heav-ily prospected Hazel Green-Shullsburg area, it is possible that the north-trend-ing belt represents a unique occurrence in the region. However, a few other scattered northwest-trending ore bodies have been found both in Wisconsin and Illinois (as the Birkbeck in sec. 27, T. 29 N., R. 1 E.), and the possibility of find-ing others should not be disregarded.

Any unprospected northwest-trending syncline may be a possible ore-bear-ing structure. Those that have been drilled have shown solution-thinning in the Oilrock member and some mineralization. An interesting structure in the un-prospected area west of the principal mineralized belt is the sharp northwest-trending syncline in sec. 33, T. 29 N., R. 1 W., and sec. 4, T. 28 N., R. 1 W. (pl. 1). A vertical 6-inch calcite vein and strongly altered rock are exposed on the eastern side of the syncline in the bank of the Sinsinawa River a few hundred feet north of the highway bridge. The calcite vein has a northwest strike par-allel to the axis of the syncline. As shown by outcrops, the structure rises rap-idly to the east, but whether the rise is caused by a fault or a sharp flexure can-not be determined because of a 100-foot-wide covered zone immediately east of the vertical vein.

### EAST-TRENDING ORE BODIES

The east-trending ore bodies of the Upper Mississippi Valley district occur en echelon along the major northeast-trending synclines or lie along the sub-sidiary east-trending synclines. Curved or arcuate ore bodies are most com-mon, but linear ore bodies that trend east have been found in Wisconsin, chiefly along the east-trending synclines (Agnew, 1955).

Only a few east-trending ore bodies, all arcuate, have been found in Illi-nois, although the majority of the ore bodies in Wisconsin have this orientation. Arcuate ore bodies are numerous in the Hazel Green-Shullsburg subdistrict in Wisconsin, where they occur en echelon along northeast-trending synclines (Ag-new et al., 1948) of about the same magnitude as the northeast-trending Vinegar Hill, Galena, and Smallpox Creek synclines of Illinois (pl. 1). Of these, only the Vinegar Hill syncline is known to have important arcuate ore bodies - the North Unity, South Unity, Hughlett and Gray, and Vinegar Hill - all clustered in a one-square-mile area near the Wisconsin-Illinois boundary (pl. 1). The other two synclines have been drilled only lightly, and their ore-bearing possibilities have by no means been thoroughly tested.

Because of the concentration of ore bodies, there has been considerable

drilling along the Vinegar Hill syncline, both in the vicinity of the ore bodies and for 3 miles to the southwest. Any future ore discoveries on this structure are most likely to be found on its extension west of the so-called principal mineralized belt (fig. 1).

Prospecting along the Galena syncline has consisted of seven or eight cross sections of drill holes, which encountered one small ore body in sec. 1, T. 28 N., R. 1 E., and an area of strong mineralization in sec. 31, T. 29 N., R. 2 E. Although drilling to date has done little to strengthen consideration of the Galena syncline as a major ore-bearing zone, it has proved the presence of mineralization, and considerable portions of the syncline remain to be prospected. The area north of the small ore body in sec. 1 merits attention because if more deposits could be found close enough to the known ore body, the group feasibly could be mined as one underground operation.

Subsidiary and crossing structures along the Galena syncline also are possible locations for ore deposition. The long subsidiary syncline branching off eastward in the southern part of sec. 30, T. 29 N., R. 2 E., then trending northeastward across secs. 29, 28, 27, 22, 23, 24, and 13, is ore-bearing in the northwestern corner of sec. 27, although, again, the ore body is small and at present probably not minable by itself. The syncline is otherwise virtually unprospected.

The east-trending synclines intersecting the Galena syncline in secs. 1 and 14, T. 28 N., R. 1 E., are favorable areas for prospecting. Such subsidiary structures in Wisconsin are commonly ore-bearing (Agnew et al., 1948).

In the Shullsburg, Wis., area, at the eastern end of the Hazel Green-Shullsburg subdistrict, a group of east-trending ore bodies, arranged en echelon, occurs in a northeast-trending belt nearly parallel to a possible extension of the Galena syncline. The ore bodies occur in shallow eastward-trending synclines that appear to branch off the extension of the Galena structure.

The Smallpox Creek syncline is the southernmost of the three major northeast-trending synclines. It is delineated almost wholly by outcrop points. Some drilling has been done well up on the flanks of the structure, but the syncline itself is virtually unprospected.

In regard to the outlying portions of the map - the Scales Mound-Schapville area on the east, the Elizabeth area on the southeast, and the Sinsinawa River and East Dubuque-Menominee areas on the west - little is known about the chances for occurrence of zinc ore bodies. Some prospect drilling for zinc has been done in the Elizabeth area, a once-important lead-producing district, but further drilling appears desirable. Drilling also has been done in the vicinity of Scales Mound and in a small way in the West Diggings region, an area of shallow lead and zinc production west of Galena. Aside from this, there has been virtually no prospect drilling in the outlying areas. As structure has been mapped in most instances on scattered outcrops, a great many of the synclines are merely indicated or suggested, and preliminary drilling would have to be aimed at proving the existence of structures as much as at finding mineralization.

The most interesting of the outlying areas where no drilling has been done is that to the west of the principal mineralized belt, where strong fracturing and calcite mineralization are much in evidence. Scattered lead diggings are reported to have had minor production. The area east of the principal miner-

alized belt shows little strong fracturing, but mineralization is indicated by the old Roxie Ann mine in sec. 1, T.28 N., R.2 E., which is reported to have had some lead production.

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